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PSYCHOLOGY AND SCIENTIFIC METHODS

HYPOTHESES AND INSTRUMENTAL LOGICIANS

THAT thinking is, in some sense or other, solving of problems which come up in the course of life; that there are often in it stages such as getting clear about the problem, and then imagining suggestions towards a solution, followed by some sort of testing of these suggestions: all this has been well made out by those who call themselves instrumental logicians. Professor John Dewey has recently told us that all judgments are practical;¹ and the typical judgments are, therefore, those wherein we decide our future conduct; judgments which, he maintains, get themselves realized true in this conduct itself. I write as one somewhat sympathetic, I think, with this school, yet as one, after all, trained in another tradition; and while verbally I might subscribe to almost all of the above, I doubt if it would mean the same to me as it does to the admiring disciple. I shall try to expound some of these same matters in my own words, and maybe the difference of viewpoint will then come out. I am not trying to refute anybody, but trying simply to find the truth.

Professor Dewey tells us to examine especially practical judgments and see how they lead to their own realization. An example might be: "I ought to go see a doctor." Very well, let us suppose a case. I am ill; I judge I ought to go and see a doctor; I do so; in spite of that I get well. Just what is proved by that process, and what realized? Professor Dewey leaves me in doubt. I can see cases where a judgment is followed by a sort of realization of itself. If I judge I am going to try and see a doctor, and if I make the effort, then indeed this judgment is followed by its own realization in my act. But so long as it is a mere statement of future fact, I do not perceive that it is so very useful in guiding conduct, hardly more so, if at all, than if I had made my judgment about the future conduct of Woodrow Wilson. But change the judgment into the forms that practically do guide action, such as, "I ought to go";

¹ That is, "practical" in the sense of not being understandable in abstraction from the total behavior process of which judgments are a part. Professor Dewey uses the term "practical judgment" to refer specifically to the typical sort mentioned in the next clause.

and immediately the judgment ceases to be completely realized or verified by any one single experience. If in the future I go, well, I go; but the "oughtness" of it depends on other considerations, and would still have existed if I had not gone. Furthermore, even in the cases that do seem realizable by my own act, such as, "I am going to make a fool of myself," the practical purpose of the judgments is, as often as not, to avoid "realizing" them; which indicates at once that their real signification is hypothetical and not categorical at all; it is, "If I continue thus, then I make a fool of myself"; and so they are shown to refer, not to future fact, but to the potentialities of the situation, and are not directly, at least, ever realized by any one particular future fact.

Had I been called upon to point out the "practical" judgments, I think I should have adduced first of all the case of the comparative judgments, judgments such as, "If I do this, result *A* follows; and if that, result *B*"; hence leading to such other comparative judgments of valuation as, "It is better to do this than to do that." I seldom catch myself saying, "This is the thing to do," that I do not find it a mere ellipsis for, "This thing is better than the other things I might do"—again a comparison. But now notice in what sense it is possible that I ever can verify the judgment, "This is better for me to do than is that." It is not in my subsequent act, for I may do *this* and get into trouble, yet be all along convinced I had got into worse trouble by doing *that*. The essence of the thing is comparison, and you can not reduce comparison simply to behavior, to the separate acts compared. It takes two members to make a comparison, and if both ways of acting were compossible, these practical comparisons had not needed to be made. I admit and I assert that these comparative judgments are practically valuable partly because they do somehow or other get tested in subsequent experience, but the precise "how" of it is, I take it, not so simple a matter as instrumental logicians wish to make out.

That all our thinking is deferred action, was a thought which came to me first with something of the thrill of a new revelation. Like the instrumentalists, I failed to note as clearly as I now think I should have done, what sort of a difference it makes in the acting to have it deferred. I saw the likeness and slurred over the difference. I should now lay rather more stress on the deferring than on the acting. Action is by trial and error; thinking is trial and error, too, a "thought experiment," as Mach says. But there is a difference. In action I come up against the unanalyzed thing; in the thought experiment, I take my past experiences apart, and try combinations of the elements,—I compare the data, and the results I infer. There is comparison in thinking. Wherever I find thought

I find comparison—everywhere, except in the instrumentalist account of thought.

But let us now consider also some other aspects of thought. Instrumental logicians often emphasize the importance of hypothesis in thinking. Of course this is not new with them. I learned of hypotheses first from the writings of Mill and Jevons and Naville, and then from C. S. Peirce. I think it can truly be said, however, that no one has made so clear as has Professor Dewey how it is that hypotheses are not peculiar to profound researches of science, but enter into the very heart of everybody's every-day thinking. It is good to have that set forth. But it is unfortunate if we forget in the crudeness of our workaday examples the subtle intricacy of the thing at its best.

Let us consider one noteworthy aspect of the hypotheses of science. There are at least two important sorts of probability. There is class-probability, which is in question when we estimate the percentage of members of a class having a certain property from observing what percentage of obtainable samples have this property, when there is no reason to suppose the samples are not fair and representative. Here we argue beyond what we observe to something homogeneous with it. And there is another sort of probability, the sort which the verification of the hypotheses of science, properly so called, always exemplifies. I verify the time of swing of a pendulum, and I make something more probable about the rate of rolling of a ball down hill or the wobble of a spinning top, things outwardly most heterogeneous with what I actually observe. No thoughtful student of mechanics can help being impressed by the systematic structure which holds these diverse things together. Now a scientific hypothesis is an hypothesis, properly so called, only when its "verification" makes something more probable which is *not* verified, that is, not, at the moment, observed. This is the very essence of scientific hypothesis: to see one thing and conclude about another. If I were to guess that to-morrow will be rainy, and then wait until to-morrow to see what happens, and if I then actually find that it is rainy, my guess was a good guess, but it was not an hypothesis. For when I look out the window at the rain, I see the whole of my conjecture realized—it has, indeed, realized itself, as Professor Dewey says—but at the end of the process I know no more than if I had waited without guessing—except indeed, for the knowledge that I am able to make guesses that sometimes come out right, which was not itself the original guess, but due to a subsequent comparison. If I had guessed that to-morrow would be rainy *because* of the appearance of the sunset, then my guess would have begun to be an embryo hypothesis; and then, when I verified it, I should have been

rendering probable, not the rain which I see, but the connection between it and the former weather signs, a connection that I do not directly observe. In verifying hypotheses we render probable, not what we observe in verifying, but something else. And the reason this is possible is that hypotheses have to do with systems,—and instrumental logicians, I understand, abhor systems and structures, and, therefore, their account is bound to miss the essence of the matter.

In the second volume of his large treatise on logic, Bernard Bosanquet has given us an account of scientific hypotheses which is almost good enough to cause one to forgive him the rest of the book, and even its philosophical background. We work with an hypothesis, as he says, by a process better called molding than verifying; we do not chuck it overboard when it fails us, we modify it. The instrumental logicians do not tell us much about this. Nor do they remind us, as does Duhem, how we seldom or never verify one hypothesis, but always a group of hypotheses, a system of them, all at once. And there is much more to be said still about hypotheses; but perhaps I have said enough to suggest why I think the instrumentalist logicians are hardly past the alphabet.

But I have a further difficulty when I try to place Professor Dewey and other instrumentalists in my own mental categories. It is because something they praise very highly in the abstract they scarcely ever mention when they come down to concrete details. I refer to the social side of the life of thought. Robinson Crusoe on his desert island might appropriate to himself almost everything that I have read from Professor Dewey about thinking. The existence of other people seems the merest accident in the process. The only person I know about, who has really tried to tell us what differences other people make to the processes of our thought, is Professor Royce. He did not succeed very well. I could wish Professor Royce had come upon his concept of "interpretation" earlier; that he might not have left it to us a mere hint. But Royce did see that we are not solipsists, and that solipsism is itself a shaky inference and not a self-evident fact;² but he saw, also, that we are,

² Those who say solipsism is logically sound but practically absurd seem to be making a confession about their own brand of logic. Their logic will invariably be found to be a logic which does not do justice to the methods of handling hypotheses and interpretations. Solipsism is "not absolutely refutable" only in the sense in which I should not be refutable if I took it on myself to maintain that the whole world with all its stars in the sky and fossils in the hills, and all its cities, and libraries, and memories in the minds of men, was created out of nothing at 3 o'clock yesterday afternoon, that is, by deliberately giving a violent interpretation to the evidence. To establish solipsism, furthermore, requires not merely that one should directly experience one's own existence,

nevertheless, in a way isolated from one another, and alone, and that we need to interpret one another to ourselves, and ourselves to one another. Interpreting is doubtless a sub-species under the instrumentalists' general head of problem-solving, but it is problem-solving of a peculiar sort, and wherein the test of the hypothesis is a peculiar test. But to me, Professor Dewey seems to talk as if oblivious of these problems; like a solipsist who prefers to call solipsism by another, gentler name, some name of magic suggestion such as "experience," but a solipsist still. I am sure he does not mean it so, his ethics is full of "social" life, almost too full; but in his logic this aspect is mentioned only, and—then waved aside.

I am not saying that Professor Royce's notion of "interpretation" is what we want, but I should like to see it, or something like it, tried out. Royce seldom wrote more powerfully than in that brief but scornful passage in the second volume of his *Problem of Christianity*, in which he dismisses as incredible the ordinary opinions as to how we are supposed to come by analogy to know about other people. Would he had given us more of construction! And, I may add, less of his absolutism! for he wastes his time, or so it seems to me, in efforts to prove there is one true interpretation of all things, when it would have been so much more plausible, as well as useful, to have acknowledged that there are many interpretations of any one thing, and all of them, if their basis in fact is well set, alike capable of being equally true interpretations, though different.

But to return to the social aspect of thought. There is a sense, there are senses, in which each of us is alone. For instance, if you see red where I see green, and what I call "red" you call "green," I suspect we might think ourselves in full accord about qualities, when we were, as a matter of fact, not. Our common meeting-ground is elsewhere; it is in the form and structure of the world. I notice you come into the house by the door, even as I do, and that you do not try to walk through the wall; that you notice likeness and difference where I do; that you act with reference to the same structure of things as I act. That is why language, because it grew out of activities, can convey information. Surely the instrumentalists ought to be interested in this. But I would remind them, also, that language to-day has come far. I do not hand over to you nowadays a thought, or even let you see any very intelligible act.

but also directly experience that other people do *not* exist, a sheer impossibility; or else it is to be done by inference and hypothesis and interpretation. In the latter case the evidence to the contrary, for any logic that properly considers the nature of evidence for hypotheses and interpretations, is overwhelming. Incidentally I may add that Professor Royce's own Absolute has a little too much of the solipsist about him, but that is another question.

What I send you is vibrations in the air or black marks on paper, stuff and gibberish *per se*. Yet there is an hypothesis in the sending; one that will not get verified directly, and awaits its verification in the terms of another hypothesis I shall make when you react, one which will endeavor to interpret your replying act. And there is an hypothesis, too, in your receiving; one wherein you will endeavor to interpret what these sounds and marks mean. It is complex; you can not make it simpler without deceiving yourself. "It is a wonderful thing, this wireless telegraphy," said someone to Marconi. "Yes," he replied, "but not so wonderful as the way we are here talking together." And I think he was right. Science is a great cooperative enterprise; and he who would understand scientific thinking must comprehend how this cooperation takes place. Yet instrumentalists, so far as I have observed, talk only of stress and conflict within what seems to be my train of thought, and tell us only how the conflict there is allayed, as if I lived alone with my dog "Experience" on Crusoe's island.

This notion of "stress" or "conflict" may well remind us of another problem. What is this stress, this conflict? It is not like the clash of fire and water; it is a more figurative, more spiritual clash. It is not merely the clash of incipient movements in my organism, which has its mechanical resultant. It is a clash which does not always arise when it ought to, though the elements are there in juxtaposition. I sometimes suspect the real problem in thinking is to get the fight started, and not to get it settled. Professor Dewey says thinking is not our usual occupation; people do not go on hunt of trouble; they think when the occasion arises. Maybe this is true of people. And it is ever so much truer of oysters, they wait for whole centuries before beginning to think at all. I do not recognize in it altogether a description of myself, who spend a considerable amount of my time hunting trouble intellectually; still less of those higher beings I admire from afar, who know how to solve problems as well as raise them. So I suggest to the instrumentalists that those notions of "conflict," "stress," "problem," which they bandy about so light-heartedly, present a very serious problem which I would urge upon their consideration. Or would they remain like the sweet and placid oysters, untroubled by such rude problems? Ignoring problems is one method of settling them, according to the enumeration by Professor Dewey.

There is still another lacuna in the instrumentalist logic. They have given us the manual of arms, or part of it, describing the tricks of thrust and parry when the enemy is upon us. But the strategy of campaigns they do not discuss. In the great cooperative enterprise of any one of the sciences, there are indeed outposts push-

ing rather blindly into the unknown. But it is true in this war, as in the wars of nations, that campaigns are won when strategic positions are seized, and as the military men say, "organized." A logic of science ought to tell us of these things. The mathematician, for example, might write down myriads of valid equations, but from the mass of them he picks out maybe just one; yet that one reveals itself a center from which radiate lines of fertile deduction which make him master of a whole new district of mathematics. Why this marvelous fertility along some lines of attack, and the sterile vanity of others? "All facts are equal for the scientist," say some philosophers. But facts are *not* all equal for the scientist; some are central, some peripheral, some fundamental, some superficial. Why is this? Again we answer that it depends on the nature of the system embodied in the things studied. But instrumental logicians say systems belong to the pre-Darwinian stage of thought, before everything began to flow like molasses. And, therefore, I have doubts as to whether they will ever be able, from their standpoint, to interpret for us the full significance of the great hypotheses and theories of science.

And so I close with a summing up of what I have said above. Instrumental logicians have a theory of how we think. But that theory omits as often as not the things we want most to know. It forgets the immense importance of understanding comparison, if we would understand thinking. Almost all thinking involves comparison, and practical thinking most of all. In telling us how judgments lead at times to their own verification, this theory forgets to tell us how it is that nine-tenths of our ordinary judgments, including all those very practical ones by aid of which we foresee and avoid trouble, are intended to avoid the verification direct, and their truth can not, therefore, consist straightforwardly in the verification of them. Their theory disregards the most specific differentia of a scientific hypothesis, not taking into account how it, unlike a mere conjecture, is intended to render probable something which may not be itself directly verified, and that it does this by verifying other parts of the same system. The instrumentalists do not make prominent enough the importance for understanding language of the fact that language was at first not for the purpose of thinking, but for the purpose of communicating, and that this communicating presupposes a structure in the world and an isolation in minds. The whole social aspect of thinking is, consequently, only vaguely alluded to in passing. Instead they concentrate on how one individual solves a problem—and it must be of one individual they speak, for my ideas never clash with yours while they are thus separated. Yet even here they do not notice how surprising it is that

individual human beings are vexed by problems at all, while individual sunflowers and printing-presses manifest no such symptoms. And, lastly, all the broader strategy of science, and the strategic importance of the great laws of science, have not yet received their attention, though it is a very vital part of how we think.

A disciple of this instrumental school recently confided to me that this sort of logic was the logic of the future. I am inclined sometimes to think it is more in the future than anywhere else. Coming to it from a study of comparative scientific methods on the one hand, and from considering the work of the mathematical logicians on the other, its inadequacy seems to me its most insistent characteristic. Perhaps I shall be told I have misunderstood; or perhaps I shall be told that all these things have been clearly explained in some treatise I have not read. I hope it is so. Meanwhile my little trench raid with gas bombs on the instrumentalists will have served its purpose if I succeed in routing out any of them into further revealing of their position.

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VOX POPULI, VOX DEI

THE French Revolution, that swept away the sacred privileges of so many princes and prelates by divine right, did not sweep away—it sanctified as if with a baptism of fire—the sentiment and the doctrine of the divine right of the nation to exist and evolve its life. The democracies of western Europe and America—the earliest in modern times—substituted popular for kingly sovereignty: *vox populi, non vox regis, vox dei*, they said; but the *principle* of the divine right of kings, its substance, was only rephrased. No provision was made for the time when machines would bring the nations of the earth together and so weld their interests that the acts of each would inevitably affect all; it was not foreseen that certain changes in the economic processes of the world would render the absolute sovereignty of each nation as autocratic toward the rest of the world as kings by divine right had ever dreamed of becoming. As a consequence, modern democracy has meant something other than popular rule. In international affairs, it has meant “secret” diplomacy, “covering notes” between rulers to supplement published understandings, surprise attacks, spheres of influence, forcible annexations, and all that is mean and predatory in foreign diplomacy; in short, it has meant drifting with the selfish and short-sighted purposes of nations, supplemented in cases of conflict between great powers by a sort of gentlemen’s duelling code called international